REMARKS

This application has been reviewed in light of the Office Action dated April 22, 2004. Claims 1-6, 9-12, 14-17, 20-23, 25-30, 33-36, 38-41, 44-47, 49-54, 57-60, 62-65, and 68-71 are presented for examination, of which Claims 1, 14, 25, 38, 49, and 62 are the independent claims. Claims 7, 8, 13, 18, 19, 24, 31, 32, 37, 42, 43, 48, 55, 56, 61, 66, 67, 72-75, and 77 have been canceled, without prejudice or disclaimer of subject matter. Claims 1-3, 10-12, 14, 15, 21-23, 25-27, 29, 33-36, 38, 39, 45-47, 49-51, 58-60, 62, 64, and 69-71 have been amended to define more clearly what Applicant regards as his invention. Favorable reconsideration is requested.

Claim 77 was objected to under 37 C.F.R.§ 1.75 as being a substantial duplicate of Claim 1. Cancellation of Claim 77 renders this objection moot.

Claims 62-74 were objected to under 37 C.F.R.§ 1.75 as being a substantial duplicate of Claims 49-61.

Claims 62-74 are computer program product claims respectively corresponding to the method Claims 14-24 and apparatus Claims 38-48. Independent Claim 62 includes the feature, not included in independent Claim 49, of forming one or more mutually exclusive regions substantially within an object represented by at least one object node, one of the regions being defined <u>by at least two region outlines</u> substantially following at least part of the predetermined outline of the object, each of the region outlines being formed from horizontal and vertical segments of a virtual grid encompassing a space in which the predetermined outlines are defined, <u>two of the at least two region outlines for a particular object being arranged on either side of the predetermined outline for the particular object such that the object comprises at least two corresponding mutually</u>

exclusive regions, where the virtual grid comprises a plurality of cells, each cell comprising a plurality of pixels both horizontally and vertically there within, and where each of the mutually exclusive regions has one or more attributes associated therewith depending on the attributes associated with the object.

Accordingly, Applicant submits that as amended, Claims 62-74 are not a substantial duplicate of Claims 49-61, and respectfully requests withdrawal of the objection under 37 C.F.R. § 1.75.

Claims 1-75 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,933,535 (*Lee et al.*), in view of U.S. Patent No. 6,215,503 (*Snyder et al.*).

As shown above, Applicant has amended independent Claims 1, 14, 25, 38, 49, and 62 in terms that more clearly define what he regards as his invention. Applicant submits that these amended independent claims, together with the remaining claims dependent thereon, are patentably distinct from the cited prior art for at least the following reasons.

The aspect of the present invention set out in independent Claim 1 is a method for generating a pixel image. The image is formed by rendering and compositing a plurality of graphical objects according to an expression tree representing a compositing expression for the image. The expression tree comprises a plurality of nodes each representing one of the objects or an operation for combining objects or the results of other operations. Each of the objects comprises a predetermined outline and one or more attributes associated therewith.

A further aspect of the present invention set forth in Claim 1 is a method of generating a pixel image, the image being formed by rendering and compositing a plurality of graphical objects according to an expression tree representing a compositing expression for the image. The expression tree comprises a plurality of nodes each representing one of the objects or an operation for combining objects or results of other operations. Each of the objects comprises a predetermined outline and one or more attributes associated therewith. The method includes, for at least one object node, forming one or more mutually exclusive regions, each of the mutually exclusive regions being defined by a region outline substantially following at least part of the predetermined outlines of the object. Each of the region outlines being formed from horizontal and vertical segments of a virtual grid encompassing a space in which the predetermined outlines are defined. The virtual grid comprises a plurality of cells, each cell comprising a plurality of pixels both horizontally and vertically there within, where each of the mutually exclusive regions have one or more attributes associated therewith depending on the attributes associated with the object.

The method also includes, for at least one operation node, forming a plurality of further mutually exclusive regions, each of the further mutually exclusive regions being formed from the horizontal and vertical segments corresponding to the mutually exclusive regions of one or more object nodes associated with the operation node. Each of the further mutually exclusive regions have one or more further attributes associated therewith, where the value of at least one of the further attributes is dependent on the values of the attributes associated with a plurality of the mutually exclusive regions of the one or more object nodes, and where one or more of the attributes associated with

the plurality of mutually exclusive regions is unused in determining the value of the at least one further attribute, thereby optimizing the determination of the at least one further attribute.

The method further includes, for at least one of the further mutually exclusive regions, determining pixel data from the further attributes with the at least one further mutually exclusive region in order to generate the image.

Among other important features of Claim 1 is, for at least one object node, forming one or more mutually exclusive regions, each of the mutually exclusive regions being defined by a region outline substantially following at least part of the predetermined outlines of the object, each of the region outlines being formed from horizontal and vertical segments of a virtual grid encompassing a space in which the predetermined outlines are defined, the virtual grid comprising a plurality of cells, each cell comprising a plurality of pixels both horizontally and vertically there within, where each of the mutually exclusive regions have one or more attributes associated therewith depending on the attributes associated with the object. Another important feature of Claim 1 is forming a plurality of further mutually exclusive regions, each of the further mutually exclusive regions being formed from the horizontal and vertical segments corresponding to the mutually exclusive regions of one or more object nodes associated with the operation node, where each of the further mutually exclusive regions have one or more further attributes associated therewith, where the value of at least one of the further attributes is dependent on the values of the attributes associated with a plurality of the mutually exclusive regions of the one or more object nodes, and where one or more of the attributes associated with the plurality of

mutually exclusive regions is unused in determining the value of the at least one further attribute, thereby optimizing the determination of the at least one further attribute.

In making the rejection of canceled Claim 7 under Section 103(a), the Examiner states that *Lee et al.* discloses a <u>hierarchically</u> structured representation of the image at Figure 25C of *Lee et al.*

The American Heritage Dictionary of the English Language, Fourth Edition, published by the Houghton Mifflin Company, defines the term "hierarchical" as of or relating to a hierarchy, and defines the term "hierarchy" as a series in which each element is graded or ranked. Further, "The Free On-line Dictionary of Computing," © 1993-2003 (accessed at www.dictionary.com) defines the term "hierarchy" in the context of computing as an inverted tree structure.

These definitions are consistent with the description of an "expression tree" (recited in Claim 1) in the present specification. For example, as described at page 1, lines 18-29, of the present specification, an expression tree offers systematic means for representing an image in terms of its constituent elements and which facilitates later rendering. Expression trees typically comprise a plurality of nodes including leaf nodes, unary nodes and binary nodes. Nodes of higher degree, or of alternative definition may also be used. A leaf node, being the outer most node of an expression tree, has no descendent nodes and represents a primitive constituent of an image. Unary nodes represent an operation which modifies the pixel data coming out of the part of the tree below the unary node. Unary nodes include such operations as color conversions, convolutions (blurring, etc.) and operations such as red-eye removal. A binary node typically branches to left and right subtrees, wherein each subtree is itself an expression

tree comprising at least one leaf node. Binary nodes represent an operation which combines the pixel data of its two children to form a single result.[1]

Lee et al. relates to processes for compressing video signals, and to an object-based digital video encoding process with error feedback. As discussed at column 29, lines 48 and 49, of *Lee et al.*, masks, objects, sprites, and other graphical features are commonly represented by their "contours". The Examiner appears to be equating the term "contours" with an object outline. As further discussed at column 29, lines 52 and 53, chain coding is a conventional process of encoding or compressing contours. Further, as discussed at column 5, lines 26 and 27, Fig 25C is a diagrammatic representation of special case chain code modifications used in the [chain coding] process of Figure 25A. Within each modification (842), a pixel sequence (844) is converted to a pixel sequence (846). Each of the pixel sequences (844) include adjacent respective pixels X^1 and X^2. As an example, for pixel sequence (844a), initial pixel alignments (850a) and (852a) represent a nonconformal right angle direction change. Accordingly, in the *Lee et al.* method, for pixel sequence (846a), pixel A of pixel sequence (844a) is omitted, resulting in a pixel direction (854a) that conforms to pixel direction (826a) (column 31, lines 15-19).

Applicant submits that the pixel sequences (e.g., 844a) of *Lee et al.* are not hierarchical in any context. Each of the arrows (e.g., 850a) of the pixel sequences (842) represent pixel directions for pixel sequences. The pixel sequences (e.g., 844a) do not include a plurality of nodes each representing one of the objects or an operation for

---

1/It is to be understood, of course, that the claim scope is not limited by the details of the described embodiments, which are referred to only to facilitate explanation.

combining objects or the results of other operations. Rather, X^1 and X^2 represent adjacent respective pixels and the arrows represent the direction between pixels A and B.

Applicant further submits that the pixel sequences of *Lee et al.* do not teach or suggest the feature of a method of generating a pixel image, the image being formed by rendering and compositing a plurality of graphical objects according to <u>an expression tree</u> representing a compositing expression for the image, the expression tree comprising a plurality of nodes each representing one of the objects, an operation for combining objects or results of other operations, where each of the objects comprises a predetermined outline and one or more attributes associated therewith, as recited in Claim 1. Rather, *Lee et al.* teaches a non-hierarchical representation of a pixel sequence and in particular, the directions of two adjacent respective pixels after modification.

Another important feature of Claim 1 is that for at least one object node (i.e., of the expression tree), one or more mutually exclusive regions are formed, where each of the mutually exclusive regions is defined by a region outline substantially following at least part of the predetermined outline of the object, and each of the region outlines being formed from horizontal and vertical segments of a virtual grid encompassing a space in which the predetermined outlines are defined, the virtual grid comprises a plurality of cells, each cell comprising a plurality of pixels both horizontally and vertically there within, wherein each of the mutually exclusive regions has one or more attributes associated therewith depending on the attributes associated with the object.

As described at page 10, lines 2-4, of the present specification, a composition is subdivided into a number of mutually exclusive irregular regions. The term mutually exclusive regions refers to non-intersecting regions (i.e., disjoint regions). Such a

subdivision allows sub-expressions corresponding to each of the mutually exclusive regions to be simplified independently within each mutually exclusive region, so as to optimize the rendering of an image without changing the original hierarchical structure representing the image.

Further, as described at page 16, lines 5-22, the efficiency of the region operations is improved by choosing horizontal and vertical segments to represent region boundaries, where as many as is practical of the horizontal and vertical segments of substantially all region boundaries are in phase. That is, the segments are chosen from the horizontal and vertical lines of the same grid. The grid need not be regularly spaced, nor have the same spacing horizontally and vertically, although typically it will. Such a grid (900) is shown in Figure 22 of the present application.

Still further, as disclosed at page 16, lines 14-17, the typical segment size is chosen so that there is neither too much detail so that the region operations are not overburdened, nor too much approximation to result in wasted compositing or insufficient optimization. For example, choosing the segment size as the distance between two adjacent pixels of an underlying pixel grid would result in too much detail so that the region operations are overburdened.

As discussed above, nothing has been found in *Lee et* al. that would teach or suggest the feature of the image being formed by rendering and compositing a plurality of graphical objects according to an expression tree representing a compositing expression for the image, where the expression tree comprises a plurality of nodes each representing one of the objects or an operation for combining objects or the results of other operations.

Similarly, nothing has been found in *Lee et al.* that would teach or suggest the feature of, for at least one object node, forming one or more mutually exclusive regions.

In making the rejection under Section 103(a), the Examiner states that *Lee et al.* discloses the step of manipulating the region outlines to determine a plurality of further regions, where each of the further regions is defined by corresponding ones of the selected horizontal and vertical segments of the virtual grid, at Figure 16.

Applicant submits that nothing has been found in *Lee et al.* that would teach or suggest the feature of each of the further mutually exclusive regions having one or more further attributes associated therewith, wherein the value of at least one of the further attributes is dependent on the values of the attributes associated with a plurality of the mutually exclusive regions of the one or more object nodes, and where one or more of the attributes associated with the plurality of mutually exclusive regions is unused in determining the value of the at least one further attribute, thereby optimizing the determination of the at least one further attribute, as recited in Claim 1.

As disclosed at page 8, lines 13-16, of the present specification, changes which can be made to the tree include geometrically transforming part or all of the tree, modifying the tree structure (un-linking and linking subtrees), and modifying attributes (e.g., color) of individual nodes. Such modifications may not necessarily mean that the tree structure, for example as seen in Figure 1, will change where only the attributes of an individual node have been modified.

Further, as disclosed at page 15, lines 23-29, a region group for a leaf node will typically contain one or more regions, which together fully contain the non-transparent area of the graphical object represented by the leaf node. Typically, the non-transparent

area is divided into regions where each region has some property that facilitates optimization. For example, the non-transparent area of some graphical object can be divided into two regions, one fully opaque and the other with ordinary opacity. Alternatively, the leaf node could be subdivided based on some other attribute. For example, a leaf node could be divided into two regions, one representing an area of constant color, the other representing blended color. Areas of constant color may be composited more efficiently than areas with more general color description.

As discussed above, *Lee et al.* is directed toward object-based video compression employing arbitrarily-shaped features. In the *Lee et al.* method, video information is compressed relative to objects or features of arbitrary configurations, rather than fixed, regular arrays of pixels as in conventional video compression methods. *Lee et al.* discusses that this reduces the error components (See Abstract).

Figure 16 of *Lee et al.* shows a fragmentary representation of display screen (50) showing a portion of image frame (202b) with an object (204b). As discussed at column 21, lines 64, to column 22, line 2, an initial transformation block (374) is defined with respect to the object (204b). *Lee et al.* discusses that the initial transformation block (374) is of maximal dimensions that are selectable by a user. The initial transformation block (374) is designated the current transformation block. Further, as discussed at column 22, line 11-13, the current transformation block (374) is subdivided into, for example, four equal sub-blocks (380a-380d), and affine transformations are determined for each of the sub-blocks (380a-380d).

Still further, as discussed at column 22, lines 32-39, function block (384) indicates that sub-blocks (380a-380d) are successively designated the current

transformation block, and each are analyzed as to whether they are to be further subdivided. Sub-block (380a) is designated the current transformation and processed according to function block (376) and further sub-divided into sub-blocks (386a-386d). Function block (388) indicates that a next successive transformation block (374') is identified and designated an initial or current transformation block.

Lee et al. discusses that the selection and subdivision of the transformation blocks reduces the error threshold. However, the sub-blocks (380a-380d) and the transformation blocks (386a-386d) disclosed at column 22 of *Lee et al.* are totally distinct from the regions (420) representing horizontal pixel segments as discussed at column 23 of *Lee et al.* That is, the sub-blocks (380a-380d) and the transformation blocks (386a-386d) are not formed from the regions (420) of Figure 18B.

Lee et al. merely discusses that pixels between an interior outline (148) and exterior outline (156) are classified according to predefined attributes as to whether they are within an object interior (144), thereby to identify automatically the object perimeter (142) and a corresponding mask (80) of the type described with reference to Figure 3A. *Lee et al.* also discusses that the image attributes include pixel color and position, but either attribute could be used alone or with other attributes (column 12, lines 5-12).

Assuming *arguendo* that the regions (420) of Figure 18B have one or more attributes associated with them depending on the horizontal pixel segments represented by the regions (420), any attributes associated with the sub-blocks (380a-380d) and/or the transformation blocks (386a-386d) are not dependent on the values of the attributes associated with a plurality of the regions (420) since the regions (420) and the sub-blocks (380a-380d) and/or the transformation blocks (386a-386d), are distinct.

Further, assuming *arguendo* that the sub-blocks (380a-380d) have one or more attributes associated with them, any attributes associated with any one of the transformation blocks (386a-386d) are not dependent on the attributes associated with a plurality of the sub-blocks (380a-380d). On the contrary, any attributes associated with any one of the transformation blocks (386a-386d) could only merely be said to be dependent on the attributes associated with ONE of the sub-blocks (380a-380d). Accordingly, Applicant submits that *Lee et al.* actually teaches away from the feature of Claim 1 that each of the further mutually exclusive regions having one or more further attributes associated therewith, where the value of at least one of the further attributes is dependent on the values of the attributes associated with a plurality of the mutually exclusive regions of the one or more object nodes.

Further, as discussed above, nothing has been found in *Lee et al.* that would teach or suggest that the image is being formed by rendering and compositing a plurality of graphical objects according to an expression tree representing a compositing expression for the image, as recited in Claim 1.

For similar reasons, Applicant submits that nothing has been found in *Lee et al.* that would teach or suggest that for at least one operation node, a plurality of further mutually exclusive regions are formed, as recited in Claim 1.

Further, Applicant submits that nothing has been found in *Lee et al.*, and particularly at column 23, that would teach or suggest, for at least one operation node, forming a plurality of further mutually exclusive regions, each of the further mutually exclusive regions being formed from the horizontal and vertical segments corresponding to the mutually exclusive regions of one or more object nodes associated with the operation

node (i.e., from the mutually exclusive regions formed <u>substantially within the object</u> represented by a node), as recited in Claim 1.

The Examiner states that *Lee et al.* fails to disclose a compositing expression for each region. Applicant concurs.

For at least the above reasons, Applicant submits that Claim 1 is clearly patentable over *Lee et al.*, taken alone.

The Examiner cites *Snyder* as remedying the deficiencies of *Lee et al.* with respect to compositing expression for each region, and that *Snyder* discloses defining image layers, i.e., regions, with compositing expressions.

Snyder relates to an image generator which takes graphical objects and an occlusion relationship for the objects and resolves non-binary occlusion cycles with image compositing operations to produce an output image of the objects.

As discussed at column 1, lines 53-55, of *Snyder*, a visible surface determination is the process of determining which surfaces of the objects in a scene are visible from the perspective of the camera. Further, column 3, lines 25-28, discusses that visibility ordering of objects is particularly useful in applications where the object geometry in a scene is factored into separate layers (e.g., factoring foreground and background objects to separate layers). Therefore, an image layer is defined by the position of objects from the perspective of the camera. If there are no image or no objects on a particular layer, then one can see through the layer to other layers behind that layer.

Column 3, lines 19-22, discusses that in layered rendering systems, objects forming occlusion cycles can be grouped into a single layer so that the hardware z-buffer is used to resolve occlusions. Therefore, an image layer is defined by the z-order of objects.

Then, at column 3, lines 58-60, *Snyder* discusses that this method is suited for layered graphics rendering pipelines where graphical objects are rendered to separate image layers and then combined to produce output images.

In the detailed description at column 7, lines 23 and 24, the method for visibility sorting is referred to as a Coherent Visibility Sort (CVS). The CVS method computes a front-to-back visibility ordering of objects in a graphics scene. Each of the objects or grouped objects in an occlusion cycle can be rendered to an image layer.

Applicant submits that the "mutually exclusive regions" of Claim 1 are distinctly different to the image layers of *Snyder*. The image layers of *Snyder* are not defined by at least one region outline substantially following at least one of the predetermined outlines or parts thereof, as recited in Claim 1. Rather, the image layers of *Snyder* are merely defined by a position or z-order of objects. The image layers of *Snyder* are essentially a cross-section of the image.

Applicant submits that a combination of *Snyder* and *Lee et al.* would fail to disclose or suggest the feature of Claim 1 of, for at least one object node, forming one or more mutually exclusive regions, each of the mutually exclusive regions being defined by a region outline substantially following at least part of the predetermined outline of the object, each of the region outlines being formed from horizontal and vertical segments of a virtual grid encompassing a space in which the predetermined outlines are defined, the virtual grid comprising a plurality of cells, each cell comprising a plurality of pixels both horizontally and vertically there within, wherein each of the mutually exclusive regions has one or more attributes associated therewith depending on the attributes associated with the object.

Further, Applicant submits that a combination of *Snyder* and *Lee et al.* would also fail to disclose or suggest that for at least one operation node, forming a plurality of further mutually exclusive regions, each of the further mutually exclusive regions being formed from the horizontal and vertical segments corresponding to the mutually exclusive regions of one or more object nodes associated with the operation node, each of the further mutually exclusive regions having one or more further attributes associated therewith, where the value of at least one of the further attributes is dependent on the values of the attributes associated with a plurality of the mutually exclusive regions of the one or more object nodes, and where one or more of the attributes associated with the plurality of mutually exclusive regions is unused in determining the value of the at least one further attribute, thereby optimizing the determination of the at least one further attribute, as further recited in Claim 1.

For at least the above reasons, Applicant submits that Claim 1 is clearly patentable over the cited prior art. Additionally, independent Claims 14, 25, 38, 49, and 62 include features similar to those discussed above in connection with Claim 1. Accordingly, Claims 14, 25, 38, 49, and 62 are believed to be patentable for reasons substantially similar to those discussed above in connection with Claim 1.

The other claims in this application are each dependent from one or another of the independent claims discussed above and are therefore believed patentable for the same reasons. Since each dependent claim is also deemed to define an additional aspect of the invention, however, the individual reconsideration of the patentability of each on its own merits is respectfully requested.

In view of the foregoing amendments and remarks, Applicant respectfully requests favorable reconsideration and early passage to issue of the present application.

Applicant's undersigned attorney may be reached in our New York office by telephone at (212) 218-2100. All correspondence should continue to be directed to our below listed address.

Respectfully submitted,

Attorney for Applicant
Ronald A. Clayton
Registration No.: 26,718

FITZPATRICK, CELLA, HARPER & SCINTO
30 Rockefeller Plaza
New York, New York 10112-3801
Facsimile: (212) 218-2200

NY_MAIN 440830v1